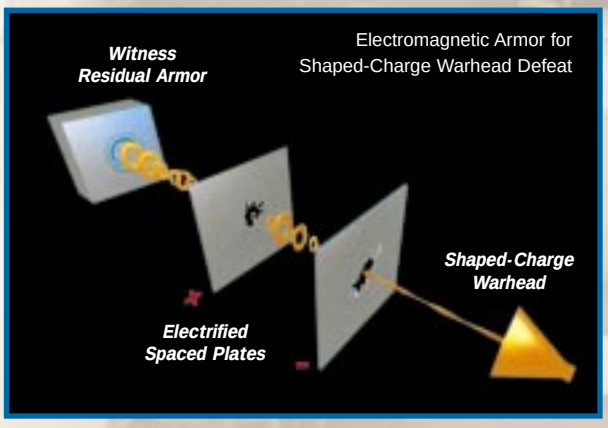
Armor Research

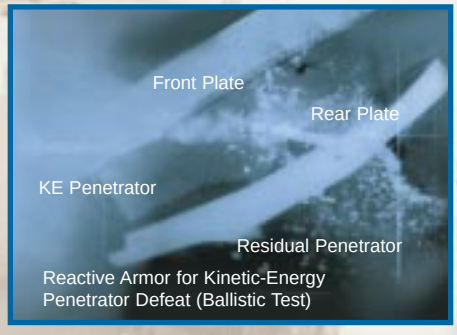
The U.S. Army Research Laboratory (ARL) is the Army's leader in the successful design and development of the armors outfitted on currently fielded combat vehicles. The special armors for the original M1 Abrams tank and all subsequent variants were designed by scientists and engineers at ARL and its predecessor, the Ballistic Research Laboratory (BRL). These armors are unique, still highly classified, and provide protection levels that render U.S. main battle tanks the most survivable in the world today. We have applied advances in terminal ballistics and materials research to other successes, such as reactive armor appliques for the M2/M3 Bradley Fighting Vehicle and M60 tank, titanium upgrades for the Bradley and Abrams, and developmental roof armors for top-attack protection in the M109A6 Paladin self-propelled howitzer.

Full-Scale Combat Vehicle Armor Characterization
(M1A2 Abrams MBT Frontal Armor Test)



Electromagnetic Armor for
Shaped-Charge Warhead Defeat

ARL scientists and engineers investigate the physics of target/penetrator interactions and apply that knowledge to the defeat of all classes of anti-armor weapons. Specifically, the Weapons and Materials Research Directorate at ARL's Aberdeen Proving Ground campus has the primary responsibility for the successful design of new armors on current and future combat vehicles. The directorate maintains an extensive experimental and computational capability and features an expert staff of scientists and engineers. Together, these resources and capabilities enable ARL to remain at the forefront of armor research.



Reactive Armor for Kinetic-Energy
Penetrator Defeat (Ballistic Test)

Future Combat System Concept Illustration
showing Armor Defeat of Anti-Armor Threat

Experimental Image Analysis Laboratory

PEO GCSS

GENERAL DYNAMICS
Land Systems Division

United Defense

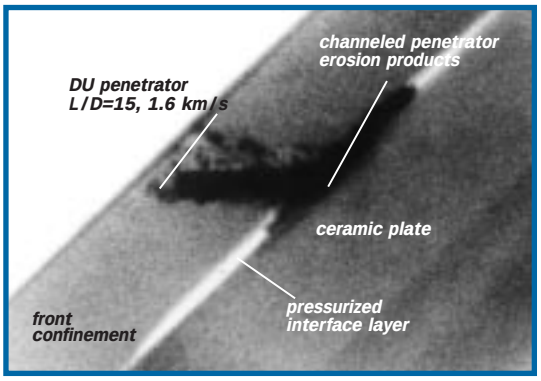
ABRAMS TANK SYSTEM

BRADLEY

EXPERIMENTATION

- Wide Variety of Ballistic Test Facilities
- Testing with Fielded and Experimental Explosive Anti-Armor Warheads
- Testing with Fielded and Experimental KE Penetrators up to Hypervelocity
- Target Assembly and Storage Facility
- Robust Analysis Capability
- State-of-the-Art Imaging Laboratory
- Materials Processing and Characterization Laboratories

Hot Isostatic Press Processing of Armor Ceramics



Ceramic Armor Interface Defeat of KE Penetrators

Shaped-Charge/Armor Experimental Facility

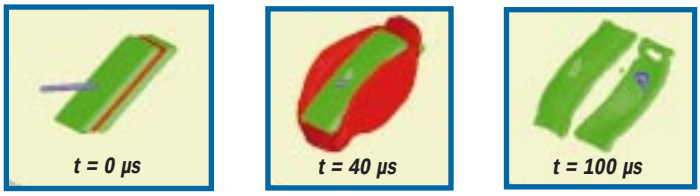
This facility is used to evaluate armors designed to defeat "chemical-energy" warheads—both shaped-charge warheads and explosively formed penetrators. It features four active test sites. One site is used to test reactive armor and electromagnetic armor vs. warheads of up to 7" in diameter. A second, large-scale target site has no limit on warhead size. Both sites are capable of testing armors against tandem shaped-charge warheads. A horizontal X-ray site features 1-MeV flash X-ray equipment and can test armors against warheads of up to 7" in diameter. A fourth site features a high-speed electronic (shuttering) camera and can test armors against precision shaped-charge warheads of up to 3.2" in diameter.

Large and Small Caliber Armor Research Facility

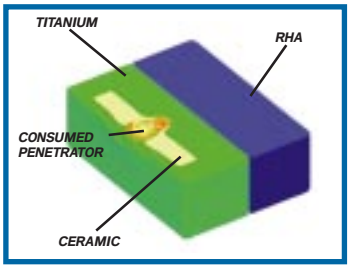
This environmentally contained outdoor complex contains complete diagnostics to analyze the performance of classified armor technologies against kinetic-energy penetrators, including depleted-uranium armors and munitions. The large-caliber section allows testing of kinetic-energy penetrators fired from gun bores of up to 7" in diameter. Flight parameters (velocity, yaw, and pitch) are measured with 150-keV flash X-ray instrumentation, and target/penetrator interaction is measured with 1-MeV X-ray instrumentation. The small-caliber section allows scale-model testing of armors vs. rounds fired from gun bores of up to 40 mm in diameter. It is equipped to test small shaped-charge munitions and reactive armor. Instrumentation includes 1-MeV flash X-ray equipment.

MODELING AND SIMULATION

ARL has an established capability in understanding the underlying penetration mechanics for a wide range of defeat mechanisms against shaped-charge, kinetic-energy, explosively formed, and high-explosive munition threats. These mechanisms are intensively studied using advanced numerical models of armor/anti-armor phenomena such as high-rate material deformation, explosive initiation, adiabatic shear, and time-dependent variations in stress, strain, and fracture. These models are applied to computational mechanics codes to provide an advanced simulation capability that complements experimentation by revealing details not available by experimental techniques, by minimizing expensive parametric studies, and by screening of new armor concepts. The collocation of the Army Major Shared Resource Center at ARL's Aberdeen Proving Ground campus provides a significant enabling capability in high performance computing and scientific visualization for armor mechanics simulations.



Three-Dimensional CTH Simulation Long-Rod Penetrator Interacts with Explosively Launched Armor Steel (RHA) Plates



Three-Dimensional CTH Simulation Ceramic/Titanium Armor

FOR FURTHER INFORMATION

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AMERICA'S ARSENAL FOR THE BRAVE